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Understanding how the framing of information influences the expectations of respondents in surveys regarding inflation: A study of graphical and textual information.

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The views stated in this thesis are those of the author and not necessarily those of the supervisor, second assessor, Erasmus School of Economics or Erasmus University Rotterdam.

Abstract

The purpose of this paper is to understand whether the framing of inflation information has an effect on the expectations in inflation surveys. Specifically, this paper analyzes the differences between the graphical and textual framing of information. To collect data for this paper, a survey was conducted that asked respondents to predict future inflation based on historical inflation data. The data was analyzed using linear regressions and Mann-Whitney U tests. This research found that the framing of inflation information has a significant effect on the accuracy of expectations: the accuracy of the graphical frame is higher compared to expectations made using the textual frame. Inflation surveys are used by policy makers and central banks to understand consumer sentiment regarding inflation and the economy. These surveys are utilized when making important decisions in their effort to counter inflation and maintain price stability. However, these surveys suffer from overestimation. The findings of this paper emphasize the importance of inquiring about the primary source from which individuals receive their inflation information from, as different sources utilize the graphical and textual framing to different extents. Controlling for this can improve the accuracy of expectations in inflation surveys.

Table of Contents

Introduction	4
Literature Review	6
i. Framing of Information: Graph vs Text	6
ii. Aligned Preferences	8
iii. Level of Informedness	9
iv. Demographics	10
v. Wording	12
vi. Single Value Answers vs Predefined Ranges	12
Methodology and Analysis	
i. Scenarios	13
ii. Framing of Information	14
iii. Demographic Questions	15
iv. Additional Questions on Preference, Source and Informedness	16
v. Incentive	17
vi. Dependent Variables	17
vii. Data Cleaning	17
viii. Tests Used for Data Analysis	18
Results	
i. Describing the Data	19
ii. Linear Regressions	23
iii. Mann-Whitney U Tests	24
Discussion	30
i. Discussing the results	31
ii. Limitations of the research	35
Conclusion	36
References	37
Appendix	
i. Primary source for inflation information amongst different demographics	39
ii. Scenarios used in the survey	40
iii. Testing for the assumption of linearity	48
iv. Testing for the assumption of multicollinearity	51

Introduction

Surveys have been used extensively by policy makers and central banks to gain insight into the inflation expectations of people. Central banks are tasked with difficult job of ensuring price stability, and a deeper understanding of consumer sentiment about the economy is critical for making informed monetary decisions (Cunningham et al., 2010). The Michigan Survey of Consumers and the Livingston Survey are examples of such surveys currently being utilized by policy makers and the Federal Reserve System in the United States (Ang et al., 2007). Information obtained through surveys may not be the only factor that influences the decision of policy makers and central banks, but it remains an integral part in the decision-making process. In times of inflation, this information is taken into account when implementing changes in the rate of interest. Vice versa, policy makers can influence consumer expectations by proposing to adjust interest rates. This process is known as forward guidance and it has become a primary tool for monetary policy (McKay et al., 2016).

Consumers manifest their expectations through fiscal behavior: spending, saving and investing. Fiscal behavior can exacerbate economic conditions such as inflation. This underlines the importance for central banks to monitor consumer expectations diligently, even in times of economic stability (Armantier et al., 2013). The objective of central banks is best explained by a quote from Alan Greenspan who was the former chair of the Federal Reserve: “more than eliminating inflation, it is also about eliminating the expectation of inflation” (Bryan and Venkatu, 2001).

There is a commonality shared by inflation surveys, which is the overestimation of consumer expectations. Bryan and Venkatu (2001) found that the average inflation expectations in the Michigan Survey of Consumers from 1990 to 1999 consistently overestimated inflation. Several studies have been conducted into identifying the causes for this persistent overestimation. Bryan and Venkatu (2001) and D’Acunto et al. (2022) are examples of such studies that focused on the disparities of expectations amongst different demographic groups. Levelt (2021) found that respondents tend to have an upward bias in their expectations; the majority of responses predicted inflation to increase over time. Bruine de Bruin et al. (2012) analyzed the effect of the wording used in questions in inflation surveys . The findings of these papers will be analyzed further in the next section.

This paper will focus on the effect of different framings of information regarding inflation. Consumer expectations are primarily impacted by their exposure to inflation in the real world such as volatile grocery prices during times of inflation (D’Acunto et al., 2021). However, consumer expectations can also be impacted by what they learn from the media (Bruine de Bruin et al., 2012). There are various

sources of media such as radio-broadcasted news, newspapers, televised news and social media. Each media source utilizes different framings of information to various extents. In this paper, the graphical and textual framing of information will be analyzed in the context of inflation surveys. The following research question will be answered:

How does the framing effect of graphically or textually presented information influence the expectations of respondents in surveys regarding inflation?

Different modes that are used for the framing of information are never inherently worse than one or the other. The effectiveness of a certain frame can be boiled down to two components: what does the reader need to understand, and what is the most effective mode to convey that information to the reader in order to process that information (Vessey, 1991). In terms of increasing the reliability of inflation expectations based on historical data, the ultimate goal of the research in this paper is to identify whether the graphical or textual framing of information is more effective in conveying the information to the respondent.

This question will be analyzed primarily through the lens of the different framing of information, focusing on the accuracy as well as the magnitude of predictions. However, the research will also dig deeper to understand whether aligned preferences, level of informedness and the demographics of respondents cause significant differences in predictions, and whether these effects hold in both frames. If such differences only occur in one of the frames, this might indicate that a specific frame intensifies the disparity between certain groups. For the respondents that participated in the survey conducted for this paper, obtaining inflation information online (google, online media, apps or social media) was the primary source for most demographics. Televised news was a close second. The only exception was for respondents aged 45 years or older; televised news was their primary source of inflation. This is shown in the appendix in Table 25. Any significant differences that are found amongst different demographic groups in the research can be analyzed further by looking at their primary source for obtaining inflation information.

By answering the research question there is the potential for certain contributions to be made in order to assist with improving the quality of future inflation surveys and research. In the literature review, several hypotheses will be proposed based on the findings of previous studies. The methodology section will describe the experiment used in this research and the different types of tests used to analyze the data. This will be followed by the results section. A discussion of the findings will follow, including the

limitations encountered in this research. The conclusion will contain any implications of the findings for the future.

Literature Review

A study conducted in 2007 found that surveys forecast inflation more accurately than macro variables or asset markets (Ang et al., 2007). Ang et al. (2007) compared inflation forecasts produced by information from surveys regarding inflation expectations to inflation forecasts produced by using time-series models, the Phillips Curve and term structure models. The specific surveys utilized by Ang et al. were the Michigan Survey of Consumers, the Livingston Survey and the Survey of Professional Forecasters. Ang et al. found that the surveys produced better forecasts with regards to measuring the Consumer Price Index compared to the other methods. Ang et al. gave a few reasons as to why surveys forecast inflation more accurately than the other methods. First, surveys do a better job of efficiently aggregating a large amount of information, which is difficult to capture by a single model. Second, the information collected in surveys is not present in other methods of forecasting inflation. Finally, Ang et al. suggests that surveys are able to react faster to changes in the data generating process with regards to inflation, compared to the other methods of forecasting inflation. As shown by the findings of Ang et al., the continued use and further development of inflation surveys is imperative for making effective monetary policies.

i. Framing of Information: Graph vs Text

Graphs are a common mode of representing data in way which makes it easier for a reader to visualize the data points and to identify any trends, such as the overall trajectory of the data and any significant deviations (Franzblau and Chung, 2012). On the other hand, summarizing the data into a textual format will include a description of the data, such as mentioning the start and end points, highs and lows, averages or any significant events in more detail. Therefore, both the graphical and textual framing of information have their own advantages.

Prasad and Ojha (2012) conducted a randomized within-subjects experiment to understand the efficiency of different modes used to present information in textbooks. Specifically, Prasad and Ojha were interested in tables, graphs and texts, and the efficiency of these modes in conveying the information to students. To test the efficiency, the experiment conducted a test to determine the speed

and accuracy in which a student is able to process information provided via different modes. Accuracy was determined by comparing the given answer to the expected or target answer. Different questions included either one of the three modes and the sequence of questions presented to respondents were randomized. The main hypothesis of Prasad and Ojha was that the graphical framing of information would prove to be the faster and more accurate of the three.

The results of the experiment regarding accuracy were as follows: In terms of student comprehension, tables proved to be the most accurate, followed by graphs and then texts (Prasad and Ojha, 2012). The difference between the accuracy of tables and graphs were smaller than the difference between the accuracy of graphs and texts. The graphical framing was also the easiest frame to interpret in terms of time.

Niu and Harvey (2021) conducted a study to understand the effect of “information contexts” and “task contexts” on the estimations of respondents in surveys regarding inflation. Niu and Harvey wanted to understand whether these effects could influence the tendency of respondents to overestimate inflation. Harvey described “information context” as the information provided to respondents prior to making an estimation regarding inflation; tasks performed by respondents prior to making an estimation about inflation is known as “task context”. This experiment consisted of three different experiments.

In the first experiment, Niu and Harvey (2021) found that providing prior inflation information increased the homogeneity of estimated inflation rates as well as reducing overestimation and the absolute error. However, the responses were still higher than the realized/actual rate of inflation. Niu and Harvey also found that providing information about the last five years of inflation increased this effect compared to only providing inflation information of the last year. In the second experiment, Niu and Harvey found evidence that respondents expected inflation to increase with time if they had to provide inflation estimation for two consecutive years. In the third experiment, Niu and Harvey were able to understand that task contexts caused responses to be influenced by the initial performed task. For example, the second experiment asked respondents to estimate inflation for two consecutive years. Therefore, the first estimation acted as a frame of reference for the second estimation. This effect combined with the respondents’ expectations of inflation to increase over time contributed to overestimation. This is similar to the aforementioned study of Levelt (2021), which found that respondents tend to have an upward bias in their expectations. This effect was not seen when different respondents only estimated one of the consecutive years.

This study will analyze future inflation predictions of individuals after providing them with historical inflation data in either the graphical or textual frame. This is described in the methodology section. As mentioned earlier, Vessey (1991) emphasizes that the effectiveness of one frame over the other depends on what is being asked of the reader. A graph can be utilized to assist the reader in visualizing the temporal inflation data and its trajectory (Franzblau and Chung, 2012). The study of Prasad and Ojha (2012) showed that graphs are a better mode of conveying information compared to textual information. The study of Niu and Harvey (2021) shows that providing more information to respondents in inflation survey reduces overestimation and the absolute error of estimations. In response to Vessey (1991) based on the aforementioned literature, a graph is better suited for making inflation predictions when providing historical data. A graph includes all the data points, whereas a text does not mention each separate data point. A graph will include all the data that a text can provide (highs and lows, start and ends points or any significant deviations). The only benefit of the textual framing of information is that the reader could be provided with certain descriptive statistics such as the mean or median of the historical data. In terms of making future inflation predictions based on historical data, the visualization of the data and its trajectory is more useful than the average of the data. Therefore, the first hypotheses are formed to understand whether the aforementioned literature can be combined into the context of inflation surveys. Specifically, the hypotheses will analyze whether inflation information presented in graphs produce significantly different estimations than the same information condensed into a textual format.

H1.1: *The graphical frame will produce more accurate predictions compared to the textual frame.*

H1.2: *The textual frame will overestimate predictions compared to the graphical frame.*

ii. Aligned Preferences

The survey conducted for this paper asks respondents to specify their preferred format for receiving inflation information; namely, the graphical or textual frame. This is explained in the methodology section. The purpose of this question is understand whether aligned preferences, specifically regarding the framing on information related to inflation, has an effect on the predictions of respondents. If a respondent prefers a textual framing of information over a graph, and they are assigned the textual frame in the survey, this may improve the quality of predictions. Preferences may be caused by a higher exposure to a certain framing of information. This will increase the familiarity of the respondent with the specific frame, which can potentially improve the likelihood that the information is effectively

conveyed to the individual. This effect was found in study conducted by Manahova et al. (2020). Manahova et al. found that familiarity with certain stimuli was correlated with an improved processing of information related to that stimuli. This leads to the second hypotheses, which will analyze the effect of aligned framing preferences on the accuracy and magnitude of the expectations of respondents.

H2.1: *Aligned preferences will produce more accurate predictions.*

H2.2: *Unaligned preferences will overestimate predictions.*

iii. Level of Informedness

A study conducted by Binder and Rodrigue (2018) analyzed the effect of the level of informedness (regarding inflation) on inflation expectations. Binder and Rodrigue found that a lower level of informedness causes inflation expectations to have a relatively high spread with the actual/realized rate of inflation. Binder and Rodrigue argued that a low level of informedness amongst respondents regarding inflationary trends and the target rate of inflation is due to the lack of communication between the government and central banks with the average citizen. Instead, Binder and Rodrigue recommend that the government and central banks take more initiatives to inform the average citizen about inflation and the target rate of inflation. A study by Rumler and Valderrama (2020) found that a higher level of education is correlated with lower expectations and that respondents with a higher level of education will rate their level of informedness higher than respondents with a lower level of education. Although a self-reported level of informedness can be prone to bias (Rosenman et al., 2011), Rumler and Valderrama (2020) also found that a higher level of education is correlated with higher levels of inflation literacy (this finding corroborates Burke and Manz (2014) and van der Crujisen et al. (2015); this will be explained later in the section). As a result, this reaffirms the overall quality of the self-reported level of informedness in their study.

Looking at the study of Rumler and Valderrama (2020), a higher level of education is correlated with lower expectations, a higher self-reported level of informedness and a higher level of inflation literacy. Therefore, the assumption can be made that a higher (self-reported) level of informedness is correlated with a higher level of inflation literacy as well as lower expectations. This would corroborate the findings of Binder and Rodrigue (2018). Based on the aforementioned literature, the third hypothesis is formed to understand whether the level of informedness of respondents regarding inflation produces significantly different estimations in the graphical and textual frames. An additional question is included to analyze the effect of the level of informedness on the accuracy of responses.

H3: Respondents that have a lower level of informedness overestimate their predictions in both frames compared to respondents with a higher level of informedness.

Additional question 1: How does the level of informedness affect the accuracy of predictions in both frames?

iv. Demographics

The disparity between inflation expectations amongst different demographics is a commonality shared across various surveys and studies. This includes but is not limited to gender, age, race, income and level of education. In a study conducted by Bryan and Venkatu (2001) for the Federal Reserve Bank of Cleveland, female respondents overestimated the level of inflation compared to male respondents and respondents with a high-school education overestimated compared to respondents with a higher level of education. Bryan and Venkatu were able to find correlation between the demographics of a respondent and their expected level of inflation.

a. Gender

A study conducted by D'Acunto et al. (2021) analyzed the causes for the disparity in inflation expectations of males and females. D'Acunto et al. labelled this occurrence as the "gender expectations gap". D'Acunto et al. concluded that the primary explanation for the gender expectations gap was due to the different extent that males and females are exposed to volatile grocery prices; changes in inflation have an immediate and direct effect on groceries. In most households, women tend to be the primary person responsible for grocery shopping. As a result, women overestimate inflation expectations compared to their male counterparts due to their direct exposure to inflation seen through the prices of groceries. In households where males and females share the responsibility of grocery shopping, there was no significant difference in their inflation expectations. In a different study, D'Acunto et al. (2022) analyzed the inflation expectations of respondents that participated in the New York Fed Survey of Consumer Expectations from 2014 to 2021. D'Acunto et al. found that female respondents have higher inflation expectations than their male counterparts. Both these studies corroborate the findings of Bryan and Venkatu (2001).

Based on these findings, the fourth hypothesis is formed to analyze whether the gender expectations gap holds in both the graphical and textual framing of information in inflation surveys.

H4: Females overestimate their predictions in both frames compared to males.

b. Age

A study conducted by Malmendier and Nagel (2016) analyzed the effect of an individual's exposure to inflation over their life-time to their inflation expectations. Malmendier and Nagel identified that an individual tends to estimate inflation based on the entirety of their personal experiences with inflation during their life-time. As a result, the age of an individual plays a significant role on their inflation expectations. Therefore, a younger individual will base their inflation expectations on more recent inflationary trends, whereas an older individual will base their expectations on inflationary trends that had occurred throughout the course of their life. Malmendier and Nagel found that younger individuals during the late 1970s and early 1980s had higher expectations for inflation compared to older individuals due to the high rates of inflation during that time. However, during the 1990s to 2010, younger individuals had lower inflation expectations due to the relatively stable and low inflation rates during that period, compared to older individuals that experienced higher inflation during the late 1970s and early 1980s.

In a 2020 study, Rumler and Valderrama (2020) found that older people had significantly higher expectations compared to younger people. Similarly, from 2014-2021, D'Acunto et al. (2022) found that respondents under the age of 40 had lower expectations compared to respondents aged 40 to 60 years old. Both these studies were able to corroborate the findings of Malmendier and Nagel (2016).

Based on the aforementioned findings, the fifth hypothesis is formed to analyze whether the age of respondents affects the magnitude of predictions in both frames.

H5: *Older respondents overestimate their predictions in both frames compared to younger respondents.*

c. Level of Education

A study conducted by Burke and Manz (2014) analyzed the effect of economic literacy on inflation expectations. In their study, Burke and Manz found a correlation between a higher level of education with a higher level of economic literacy and lower inflation expectations. Van der Crujisen et al. (2015) found a correlation between a higher level of education and a deeper knowledge of monetary policies. Similar to the findings of Burke and Manz (2014), Rumler and Valderrama (2020) found that a higher level of education is correlated with lower expectations and higher levels of inflation literacy; the latter finding supports that of Van der Crujisen et al. (2015). D'Acunto et al. (2022) analyzed the effect of education on the inflation expectations of respondents. Respondents with a college education had lower

inflation expectations, compared to respondents who did not have a college education. Responses were also less volatile for respondents with a college education.

Based on the aforementioned findings, it is clear that the level of education is correlated with economic literacy and will influence the quality of expectations. Therefore, the sixth hypothesis is formed to analyze whether the differences in predictions due to the level of education of respondents holds in both frames. In addition to analyzing the education effect on the magnitude of predictions of respondents, an additional question is formed to understand whether this effect has any influence on the accuracy of predictions.

H6: *Respondents with a lower level of education overestimate their predictions in both frames compared to respondents with a higher level of education.*

Additional question 2: *How does the level of education of respondents affect the accuracy of predictions in both frames?*

v. Wording

The framing effect plays an important role when designing surveys to measure inflation expectations. An example is the wording of questions. If the wording is ambiguous, the responses will vary significantly. A study conducted by Bruine de Bruin et al. (2012) analyzed the effect of wording in the Michigan Survey of Consumers. Bruine de Bruin et al. looked at the responses given to different questions that included the wording “prices in general” and “prices you pay” instead of “inflation”. Bruine de Bruin et al. found that there was less variation amongst the responses for questions that used the wording “inflation” as opposed to the more ambiguous wording “prices you pay” and “prices in general”. de Bruin et al. identified that the latter wording was mostly interpreted by respondents as a reflection of their personal experiences, which caused significant discrepancies in the responses. Bruine de Bruin et al. concluded that using the wording “inflation” was more effective in collecting reasonable responses from the respondents, making it more suitable for macroeconomic models. Based on the findings of Bruine de Bruin et al. (2012), the survey conducted for this paper will use the wording “inflation” instead of more ambiguous terminology.

vi. Single Value Answers vs Predefined Ranges

A survey collecting inflation expectations was administered for a study by Hayo and Meon (2021) in Germany to analyze the differences in response rates when respondents were allowed to report a single

value or prompted to choose from a list of predefined ranges. Hayo and Meon asked questions focusing on perceived past inflation and expectations for future inflation. Hayo and Meon identified that respondents were less likely to answer if they had to report a single value. Hayo and Meon emphasized that only providing a list of predefined ranges in order to increase the response rate would produce a higher amount of noise which would detract from the reliability of findings in the survey. A similar finding was found by Levelt (2021). Levelt found that respondents utilize “quantitative guidance”. However, this did not improve the quality of expectations. Learning from the findings of Hayo and Meon (2021) and Levelt (2021), the survey conducted for this paper will allow respondents to report a single value instead of providing respondents with a list of predefined ranges to choose from.

Methodology and Analysis

This section will analyze the experiment that has been designed to answer the research question. In order to collect the necessary data, the experiment was conducted in the form of a survey via Qualtrics. Participants were informed that their responses will remain anonymous.

i. Scenarios

This survey consisted of eight scenarios. Each scenario consisted of the annual inflation rate of a country over twelve periods (a year). This is the annual rate of inflation; the annual rate of inflation is the change in inflation compared to the inflation rate in the same period of the previous year. The primary goal of this survey was to ask the respondents to predict the annual rate of inflation at period thirteen. The scenarios use historical inflation rates, four from Sweden and four from the United Kingdom over the period of 2002 to 2018. For each country, two of the scenarios represented a year where the annual rate of inflation decreased over the year. Similarly, the other two scenarios from each country represented a year where the annual rate of inflation increased over the year. The participants were not informed of the specific country nor year of the information, in order to prevent the participant from looking up the correct answer, as this will skew the validity of the findings and detract from the purpose of this research.

The scenarios were presented to the participant in an order that avoids scenarios of consecutive years for one of the countries from following each other in the survey (respondents tend to view inflation as rising over time: Niu and Harvey, 2021 and Levelt, 2021). For instance, the annual rate of inflation for

Sweden during 2018 is presented as the third scenario while the annual rate of inflation for Sweden during 2017 is presented as the seventh scenario. Another measure that was implemented to avoid bias was to order the scenarios in the survey in such a way that ensures that the scenarios alternate between a year where the annual rate of inflation increased over the course of that year, followed by a scenario representing a year where the annual rate of inflation decreased over the course of that year.

To maintain consistency when conducting the analysis, the order of the scenarios was the same for all participants. The breakdown of the information used in each scenario in the survey will be included in the appendix, including the country and year used for each scenario. The participants were randomly assigned either the graphical or textual framing of information for the scenarios, for the entirety of the survey. This allows for the frame to be the control variable that sets the two groups apart. Therefore, this survey had a between-subjects design, meaning each participant was only exposed to one of the treatments.

ii. Framing of Information

a. Graphical Frame

The graph that is included below is an example of the way in which the graphical representation of information was presented to the respondent in the survey. This graph contains the annual inflation rate of Sweden from January to December 2017. The respondent was asked to predict the annual rate of inflation in period 13. Hence, Period 13 would represent the annual inflation rate in January 2018 (which was 1.6%). The respondent was made aware that the graph represents the inflation of a country over the course of a year (January to December). As mentioned above, the specific country and year remained unknown to the respondent, as this would prevent respondents from looking up the correct answer.

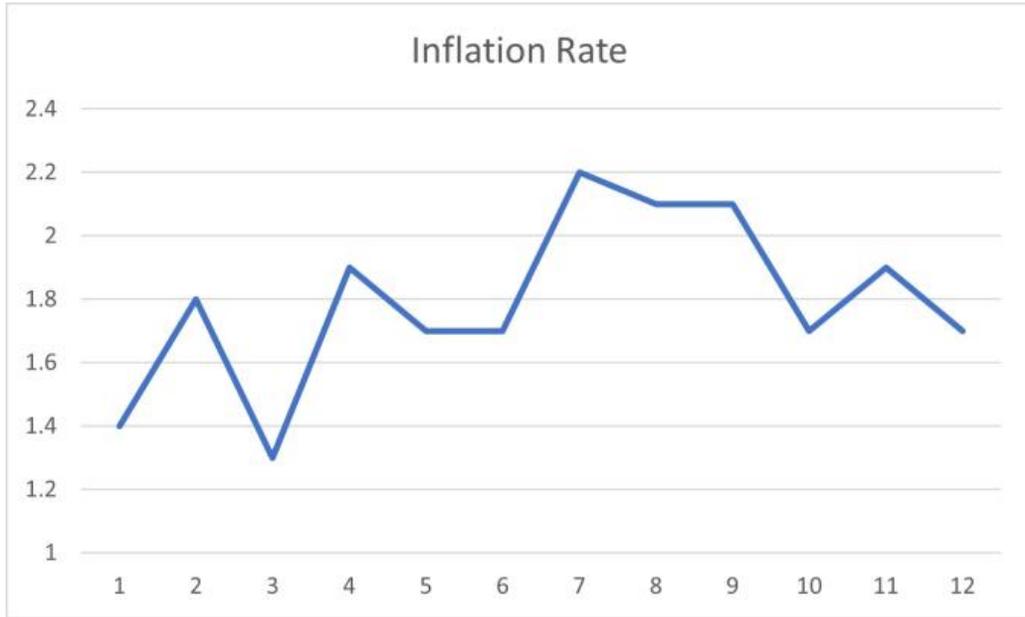


Figure 1: Example of the graphical format

b. Textual Frame

The text that is included below is an example of the way in which the textual representation of information was presented to the respondent in the survey. This information uses the same information that was used in the example above:

“The inflation rate of country G dropped from 1.8% in February to a low of 1.3% in March. The inflation rate gradually increased over the next several months, reaching a high of 2.2% in July. The remainder of the year saw steady decline in the inflation rate, falling to 1.7% in December.”

Figure 2: Example of the textual format

The graphical and textual representation for each scenario used in the survey will be provided in the appendix.

iii. Demographic Questions

Questions related to the demographics of respondents were included in the survey. The first demographic question inquired about the age of the respondent. The respondents got to choose the relevant age category to which they belong: Under 18, 18-24, 25-34, 35-44 and so forth. The second demographic question inquired about the gender of the respondent. The third demographic question

inquired about the highest level of education completed or currently being pursued by the respondent. The respondents got to choose from the following categories: High-school diploma or equivalent, Associate degree, Bachelor's degree, Master's degree or Doctoral degree. The demographic questions were asked in the beginning of the survey before the main questions (scenarios).

iv. Additional Questions on Preference, Source and Informedness

As is the case with the demographic questions, the following questions were asked prior to the main questions in the survey.

a. Preference

The respondents were asked about their preferred method of receiving information regarding the annual rate of inflation. The options were as follows: in a textual format, in a graphical format, both the textual and graphical format, or neither of these options. The reasoning behind providing this question is to analyze whether the predictions of respondents whose preference aligned with the format of information assigned to them is significantly different from the predictions of respondents whose preference did not align with the format of information they were assigned in the survey.

b. Source

The respondents were asked about their primary source for receiving information regarding the annual rate of inflation. The options were as follows: radio-broadcasted news, newspapers, televised news, online news and/or news apps, or internet search engines. The reasoning behind providing this question is due to the fact that certain sources of information utilize the textual and graphical representation to different extents. This question was not included in the final analysis.

c. Informedness

Respondents were asked to choose the level of informedness in which they believe themselves to be informed about the annual rate of inflation in the country in which they reside. Respondents could choose from a scale of 1 to 10, with 1 indicating that respondents have little to no interest in the annual rate of inflation in their country, and 10 indicating that respondents update themselves frequently on the annual rate of inflation in their country.

For the purposes of this research, analyzing the differences in the predictions of respondents, after controlling for framing and their level of informedness, will allow for a deeper look into whether the

differences in predictions are significant between respondents who consider themselves to be more informed compared to respondents who consider themselves to be less informed.

v. Incentive

Respondents were informed at the beginning of the survey that a \$25 Amazon gift card would be rewarded to the respondent with the most accurate predictions. This incentive might influence respondents, albeit slightly, to attempt to answer the main questions (scenarios) to their best of the ability. Respondents were given the opportunity at the end of the survey to include their email address for a chance to win.

vi. Dependent Variables

There are two dependent variables of interest that will be utilized in this research: total answer and total absolute error. To understand the effect of the control variable and independent variables on the magnitude of predictions, the variable measuring the total answer will be used. The total answer is the sum of the predictions for all eight scenarios, per respondent. Using this variable, it will be possible to see which groups overestimated their predictions relative to the predictions of the other groups.

Similarly, to understand the effect on the accuracy of predictions, the variable measuring the total absolute error will be used. The total absolute error is the sum of the absolute error value of predictions for each individual scenario, per respondent. Using this variable, it will be possible to see which groups had a lower total absolute error, which would imply more accurate predictions (relative to the other group).

vii. Data Cleaning

To increase the number of respondents, this survey was posted on different social media websites such as LinkedIn. This resulted in several spam/bot responses. This could be seen through duplicate IP addresses, email addresses and the amount of time taken to answer each of the main questions. Several steps were taken to clean the data and eliminate spam/bot responses. The results section will contain a breakdown of the collected data.

1. Qualtrics had a function which highlighted spam/bot responses. These highlighted responses were deleted.

2. Responses with duplicate IP addresses and email addresses were deleted.

3. Incomplete responses were deleted.
4. Responses that contained worded instead of numerical answers to the main questions were deleted.
5. Responses that took under five seconds for any one of the main questions were deleted.
6. Responses that contained typos were deleted. For example, if a respondent answered “100” instead “10.0”, the response would be deleted as this skews the data.

viii. Tests Used for Data Analysis

a. Mann-Whitney U Test

The Mann-Whitney U test is a non-parametric test best suited to analyze the differences between two independent groups. There are a few requirements that must hold:

1. The dependent variable must be continuous.
2. There can only be one independent dichotomous variable used in the test. A dichotomous variable consists of two categories.
3. Observations need to be independent.

The Mann-Whitney U test is ideal for testing the main hypotheses (H1.1 and H1.2). The dependent variable (the variable measuring total answer and the variable measuring total absolute error) is continuous and the independent control variable for frame is dichotomous. Each observation is independent from one another. Finally, the two groups are independent as the respondents are randomly assigned either the graphical or textual framing on information.

If the spread and shape of the distribution of two groups is identical, the Mann-Whitney U tests for differences between the medians of the two groups. However, if the spread/shape of the distribution of the two groups is different, then the Mann-Whitney U tests for significant differences between the spread/shape of the distribution of the two groups.

b. Linear Regression

A linear regression is best suited to analyze the effect of one or more independent variables on the dependent variable. There are five main assumptions that have to be met for a linear regression (Schreiber-Gregory and Bader, 2018). According to Schreiber-Gregory and Bader, the assumption of

autocorrelation matters in a time-series regression. As a result, autocorrelation will not be tested for in this research. The remaining four assumptions are as follows:

1. A linear relationship must exist between the dependent variable and independent variable(s). This can be tested by utilizing a scatterplot that includes the line of best fit.
2. There should be no multicollinearity. This means that there should be little to no correlation between the independent variables. This can be tested by using a correlation matrix.
3. The residuals must be normally distributed. This can be tested by using the Shapiro-Wilk test for normality. The null hypothesis for the Shapiro-Wilk test assumes that the data is normally distributed. Therefore, if the null hypothesis can be rejected, this indicates that the residuals are not normally distributed.
4. The residuals must be homoskedastic. This implies that the variance of the residuals must be constant. This can be tested by using the Breusch-Pagan test for heteroskedasticity. The null hypothesis for the Breusch-Pagan test assumes that the variance of residuals is constant (homoskedastic). Therefore, if the null hypothesis can be rejected, this indicates that the residuals are heteroskedastic.

Results

i. Describing the Data

a. Frame

After implementing the data cleaning process that was outlined in the methodology section, there were 290 respondents that participated in the survey. 144 respondents were randomly assigned the textual framing of information and the other 146 respondents were assigned the graphical frame.

FRAME			
	Textual Frame	Graphical Frame	Total
Respondents	144	146	290

Table 1. Allocation of respondents per frame

b. Preference

The majority of respondents chose both the textual and graphical frame as their frame of preference for receiving inflation information. Respondents were more likely to choose the graphical framing of

information over the textual frame. The breakdown of responses for the preference question is shown in Table 2.

PREFERENCE			
	Textual Frame	Graphical Frame	<i>Total</i>
Neither	3	2	5
Textual frame	24	23	47
Graphical frame	63	49	112
Both	54	72	126

Table 2. Allocation of responses for the preference question per frame

c. Level of Informedness

Over 80% of respondents rated their level of informedness regarding inflation between 3-8. 6 was the most common answer with 49 respondents rating that as their level on informedness. For respondents assigned the textual frame, the most common response was 6 and for respondents assigned the graphical frame the most common answer was 7. The breakdown of responses for level of informedness is shown in Table 3.

INFORMEDNESS			
	Textual Frame	Graphical Frame	<i>Total</i>
1	8	3	11
2	5	6	11
3	16	12	28
4	20	14	34
5	23	22	45
6	25	24	49
7	16	28	44
8	18	22	40
9	5	8	13
10	8	7	15

Table 3. Allocation of responses for the level of informedness per frame

d. Gender

There were 185 male respondents and 105 female respondents. As shown in Table 4, the distribution of male and female respondents in both frames was relatively similar.

GENDER			
	Textual Frame	Graphical Frame	<i>Total</i>
Female	50	55	105
Male	94	91	185

Table 4. Allocation of the gender of respondents per frame

e. Age

The majority of respondents were aged 25 to 34 years old in both frames. The distribution of the age categories of respondents is shown in Table 5.

AGE			
	Textual Frame	Graphical Frame	<i>Total</i>
Under 18	1	0	1
18-24	27	22	49
25-34	55	51	106
35-44	33	25	58
45-54	10	24	34
55-64	14	15	29
65-74	4	9	13

Table 5. Allocation of age categories of respondents per frame

f. Level of Education

The majority of respondents had a bachelor's degree in both frames. The distribution of respondents with either a high-school diploma, associate degree or master's degree was relatively similar to each other in both frames. The distribution of the level education of respondents is shown in Table 6.

EDUCATION			
	Textual Frame	Graphical Frame	<i>Total</i>
High-School Diploma	19	27	46
Associate Degree	31	26	57
Bachelor's Degree	65	58	123
Master's Degree	26	26	52
Doctoral Degree	3	9	12

Table 6. Allocation of the level of education of respondents per frame

g. Magnitude of Responses

As explained in the methodology section, the variable measuring total answer is the sum of the predictions for all eight scenarios per respondent. For the total answer of respondents, the mean was 16.35 with a standard deviation of 0.96. The magnitude of responses ranged from 10.5 to 22.9. As

shown in Figure 3, the majority of responses had a total answer ranging from 15.5 to 17.5. 37 respondents had 16.2 as their total answer. Overall, 131 respondents had values ranging from 15.9 to 16.4 as their total answer.

TOTAL ANSWER				
Observations	Mean	Standard Deviation	Minimum	Maximum
290	16.3538	0.9561	10.5	22.9

Table 7: Descriptive statistics of the variable measuring total answer

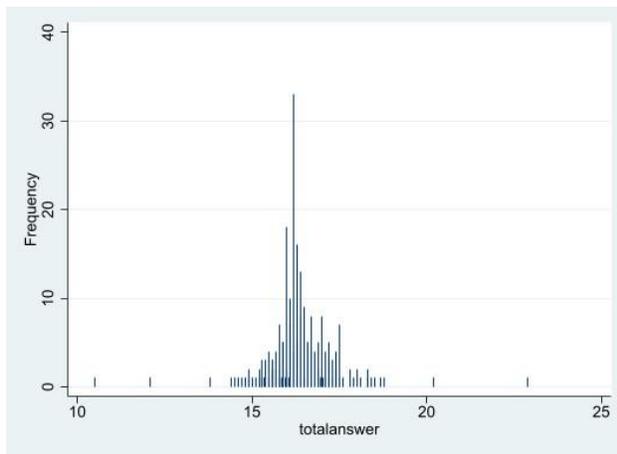


Figure 3. Frequency plot of the variable measuring total answer

h. Accuracy of Responses

As explained in the methodology section, the variable measuring total absolute error is the sum of the absolute errors for all eight scenarios per respondent. For the total absolute error of respondents, the mean was 2.46 with a standard deviation of 1.04. The total absolute error ranged from 1.2 to 9.9. As shown in Figure 4, the majority of responses had a total absolute error ranging from 1.5 to 3.5. 32 respondents had 1.8 as their total absolute error. Overall, 173 respondents had values ranging from 1.6 to 2.5 as their total absolute error.

TOTAL ABSOLUTE ERROR				
Observations	Mean	Standard Deviation	Minimum	Maximum
290	2.4641	1.0373	1.2	9.9

Table 8: Descriptive statistics of the variable measuring total absolute error

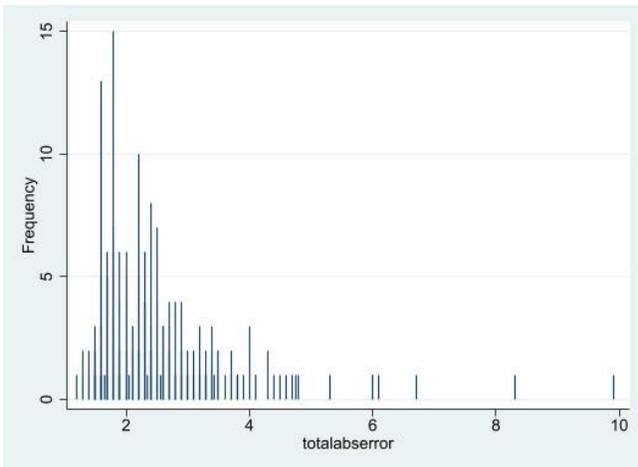


Figure 4. Frequency plot of the variable measuring total absolute error

ii. Linear Regressions

Two linear regressions were run to test the effects of the independent variables on the magnitude and accuracy of responses. A breakdown of the results is shown in Table 9. The assumption of linearity between the dependent variable and the independent variables was not violated. Similarly, the second assumption of no multicollinearity amongst the independent variables was not violated. The relevant scatterplots as well as the correlation matrix used to test for these assumptions will be included in the appendix.

		<i>Dependent Variable</i>					
		Total Answer			Total Absolute Error		
<i>Independent Variable</i>	Coefficient	Standard Error	<i>P-Value</i>	Coefficient	Standard Error	<i>P-Value</i>	
Frame	-0.0097	0.1143	0.932	-0.5243	0.1186	0.000*	
Preference	0.0799	0.0734	0.277	-0.1255	0.0765	0.102	
Informedness	-0.0347	0.0274	0.206	0.0375	0.0275	0.174	
Gender	-0.0527	0.1201	0.661				
Age	-0.0381	0.0434	0.381				
Education	0.0386	0.0554	0.486	-0.0835	0.0571	0.145	
Shapiro-Wilk Test				Shapiro-Wilk Test			
<i>P-Value: 0.0000</i>				<i>P-Value: 0.0000</i>			
Breusch-Pagan Test				Breusch-Pagan Test			
<i>P-Value: 0.0002</i>				<i>P-Value: 0.0000</i>			

Table 9. Results of the linear regressions (An asterisk next to a P-value indicates a significant effect at the 1% significance level)

For the regression testing the effect on the magnitude of responses, the total answer was used as the dependent variable. Based on the results of the regression, there were no significant effects of the

independent variables on the magnitude of responses. As a result, none of the hypotheses can be confirmed from this regression.

For the regression testing the effect on the accuracy of responses, the total absolute error was used as the dependent variable. The control variable for frame had a significant effect on the total absolute error. This effect can be interpreted in the following manner: On average, the total absolute error of a respondent using the graphical framing on information is 0.52 lower than the total absolute error of a respondent using the textual frame, *ceteris paribus*. This result confirms H1.1: the graphical frame produces more accurate predictions compared to that of the textual frame. However, none of the additional independent variables had a significant effect on the accuracy of responses.

In both of the above regressions, the assumptions of normal distribution and homoskedasticity of the residuals were violated. This is seen in through the significant results of the Shapiro-Wilk test and the Breusch-Pagan test.

iii. Mann-Whitney U Tests

As mentioned above, the linear regressions violated the assumptions of normality and homoskedasticity of the residuals. Therefore, several Mann-Whitney U tests were run as a robustness check. As explained in the analysis section, the Mann-Whitney U test is ideal for comparing the distribution of two independent groups. However, the Mann-Whitney U test requires a single dichotomous independent variable. Therefore, the categorical variables had to be divided into two groups, based on the relevant hypotheses/questions. The manner in which the categorical variables are allocated into the different groups will be specified throughout the rest of this section. The Mann-Whitney U tests have to be run separately for each frame. The results of the Mann-Whitney U tests are shown in Table 10.

INDEPENDENT VARIABLE	DEPENDENT VARIABLE	
	Total Answer	Total Absolute Error
	<i>P-Value</i>	<i>P-Value</i>
Frame	0.6125	0.0000*
Preferred Frame	0.9244	0.2673
Text_I1vI2	0.0554	0.7028
Graph_I1vI2	0.6792	0.9960
Text_FvM	0.7228	
Graph_FvM	0.2215	
Text_A1vA2	0.3046	
Graph_A1vA2	0.8720	
Text_E1vE2	0.4943	0.0071*
Graph_E1vE2	0.1407	0.7248

Table 10. Results of the Mann-Whitney U tests (An asterisk next to a P-value indicates a significant effect at the 1% significance level; I-Informedness category; F-Female; M-Male; A-Age category; E-Education category)

As seen in Table 10, the framing of information had a significant effect on the total absolute error between both groups. Additionally, the level of education had a significant effect on the total absolute error in the textual frame.

a. Frame

The framing of information had a significant effect on the accuracy of responses between both groups. This result indicates that there exists a significant difference between the spread and shape of the distribution of both groups. As shown in Table 11, on average, respondents assigned the textual frame had a total absolute error that was 0.5 higher than respondents assigned the graphical frame. This result confirms H1.1; on average, the accuracy of predictions for a respondent assigned the graphical frame is more accurate and significantly different compared to a respondent that was assigned the textual frame. This finding corroborates the result of linear regression testing for the effects on the total absolute error (Table 9).

	FRAME	
	Average Total Absolute Error	Difference
Textual Frame	2.7	0.5*
Graphical Frame	2.2	

Table 11. Average total absolute error per frame

On the other hand, the framing of information had did not have significant effect on the magnitude of responses between both groups. As shown in Table 12, there was only a difference of 0.1 between the

total answer of respondents in the textual and graphical frame. As a result, H1.2 (the textual frame overestimates predictions compared to the graphical frame) cannot be confirmed.

FRAME		
	Average Total Answer	Difference
Textual Frame	16.4	0.1
Graphical Frame	16.3	

Table 12. Average total answer per frame

b. Aligned Preferences

As explained in the methodology section, the question inquiring about preferences was included in the survey to understand if a respondent’s frame of preference aligned with the framing of information to which they were assigned had a significant effect on the magnitude and accuracy of predictions, compared to a respondent that was assigned the frame that did not align with their frame of preference. In order to test this in a Mann-Whitney U test, responses were allocated into two categories, as shown in Table 13. Responses that chose both the textual and graphical frame as their frame of preference were not included. In total, 91 respondents were not assigned the frame that aligned with their preference whereas 73 respondents were assigned the frame matching their preference.

PREFERENCE	
	Total
Preferred Frame: No	91
Preferred Frame: Yes	73
	164

Table 13. Allocation of respondents based on aligned preferences

The aligning of preferences did not have significant effect on the accuracy nor magnitude of responses between both groups. As shown in Table 14 and 15, there was only a difference of 0.1 for the total answer as well as the total absolute error of respondents in the textual and graphical frame. Based on these results, the aligning of preferences does not have any effect on predictions. Therefore, neither H2.1 (aligned preferences produce more accurate predictions) nor H2.2 (unaligned preferences overestimate compared to that of aligned preferences) can be confirmed.

PREFERENCE		
	Average Total Absolute Error	Difference
Preferred Frame: No	2.6	0.1
Preferred Frame: Yes	2.5	

Table 14. Average total absolute error for both aligned preference categories

PREFERENCE		
	Average Total Answer	Difference
Preferred Frame: No	16.3	-0.1
Preferred Frame: Yes	16.4	

Table 15. Average total answer for both aligned preference categories

c. Level of Informedness

As explained in the methodology section, the question inquiring about the level of informedness of respondents regarding inflation was included in the survey to understand whether informedness had a significant effect on the magnitude and accuracy of predictions. Respondents were divided into two categories, as shown in Table 16. Informedness category 1 consisted of respondents that reported their level of informedness from 1 to 5 and informedness category 2 consisted of respondents that reported 6 to 10. This is in line with H3: respondents with a lower level of informedness overestimate their predictions in both frames compared to that of respondents with a higher level of informedness. In the textual frame, there was an equal distribution of respondents in both of the informedness categories. However, in the graphical frame, the majority of respondent were allocated to informedness category 2.

INFORMEDNESS			
	Textual Frame	Graphical Frame	Total
Informedness Category 1 (I1)	72	57	129
Informedness Category 2 (I2)	72	89	161

Table 16. Allocation of respondents based on their level of informedness

The level of informedness of respondents did not have a significant effect on the magnitude of responses in either frame. As shown in Table 17, there was only a 0.1 difference between the average total answer of both informedness categories in the graphical frame. However, respondents with a lower level informedness had an average total answer that was 0.4 higher than respondents with a higher level of informedness in the textual frame. Due to the lack of significant effects, H3 cannot be confirmed. Nonetheless, it is evident that the level of informedness affects the magnitude of responses in the textual frame.

INFORMEDNESS				
	Textual Frame		Graphical Frame	
	Average Total Answer	Difference	Average Total Answer	Difference
I1	16.6	0.4	16.4	0.1
I2	16.2		16.3	

Table 17. Average total answer for each informedness category per frame

To answer additional question 1, the level of informedness of respondents did not have a significant effect on the accuracy of responses in either frame. As shown in Table 18, there was only a 0.1 difference between the average total absolute error of both informedness categories in each frame.

INFORMEDNESS				
	Textual Frame		Graphical Frame	
	Average Total Absolute Error	Difference	Average Total Absolute Error	Difference
I1	2.7	-0.1	2.1	-0.1
I2	2.8		2.2	

Table 18. Average total absolute error for each informedness category per frame

d. Gender

The gender of respondents did not have a significant effect on the magnitude of responses in either frame. There was only a difference of 0.1 between the average total answer of female and male respondent in the textual frame. In the graphical frame, female respondents had an average total answer that 0.3 higher than those of their male counterparts. This is in line with H4 and the literature: women overestimate compared to men. H4 cannot be confirmed due to the lack of significant effects, however it is clear that gender plays more of a role in impacting the magnitude of responses in the graphical frame.

GENDER				
	Textual Frame		Graphical Frame	
	Average Total Answer	Difference	Average Total Answer	Difference
Female	16.3	-0.1	16.5	0.3
Male	16.4		16.2	

Table 19. Average total answer for each gender per frame

e. Age

Respondents were divided into two categories based on their age, as shown in Table 20. Age category 1 consisted of younger respondents aged 18 to 34 years old; age category 2 consisted of older respondents aged 35 to 74 years old. This allows for H5 to be tested: older respondents overestimate

their predictions in both frames compared to younger respondents. In the graphical frame, there was an equal distribution of respondents in both of the age categories. However, in the textual frame, the majority of respondent fell into age category 1.

AGE			
	Textual Frame	Graphical Frame	<i>Total</i>
Age Category 1 (A1)	83	73	156
Age Category 2 (A2)	61	73	134

Table 20. Table 16. Allocation of respondents based on their age

The age of respondents does not have a significant effect on the magnitude of predictions in both frames. In the textual frame, there was only a difference of 0.1 between the average total answer of younger and older respondents. There was no difference in the graphical frame. As a result, H5 cannot be confirmed.

AGE				
	Textual Frame		Graphical Frame	
	Average Total Answer	<i>Difference</i>	Average Total Answer	<i>Difference</i>
A1	16.4		16.3	
A2	16.3	0.1	16.3	0.0

Table 21. Average total answer for each age category per frame

f. Level of Education

H6 predicts that respondents with a lower level of education will overestimate compared to respondents with a higher level of education in both frames. Therefore, respondents were divided into two categories, as shown in Table 22. Education category 1 consisted of respondents with a low level of education (high-school diploma or an Associate degree); education category 2 consisted of respondents with a high level of education (Bachelor’s degree, Master’s degree or a Doctoral degree). In both frames, the majority of respondents fell into education category 2. However, there was a relatively similar distribution of respondents in each education category across both frames.

EDUCATION			
	Textual Frame	Graphical Frame	<i>Total</i>
Education Category 1 (E1)	50	53	103
Education Category 2 (E2)	94	93	187

Table 22. Allocation of respondents based on their level of education

The level of education did not have a significant effect on the magnitude of predictions in either frame. There was only a difference of 0.1 between the average total answer of respondents in each education category in both the textual and graphical frame. As a result, H6 cannot be confirmed.

EDUCATION				
Textual Frame			Graphical Frame	
	Average Total Answer	Difference	Average Total Answer	Difference
E1	16.4	0.1	16.3	-0.1
E2	16.3		16.4	

Table 23. Average total answer for each education category per frame

To answer additional question 2, the level of education of did not have a significant effect on the accuracy of responses in the graphical frame. In fact, there was no difference between the average total absolute error of respondents with a lower level of education and a higher level of education. However, the level of education had a significant effect on the accuracy of responses in the textual frame. As shown in Table 24, respondents with a lower level of education had an average total absolute error that was 0.4 higher than their counterparts. It is important to note that this effect does not imply causation, as there are several factors that could influence education. Yet, this effect shows that there is a correlation between the level of education of a respondent and the total absolute error of their predictions in the textual frame.

EDUCATION				
Textual Frame			Graphical Frame	
	Average Total Absolute Error	Difference	Average Total Absolute Error	Difference
E1	3.0	0.4*	2.2	0.0
E2	2.6		2.2	

Table 24. Average total absolute error for each education category per frame

Discussion

This section will discuss the importance of the findings in the results section and how the significant effects (or lack thereof) can be explained by the literature. In the introduction, it was found that online sources were the primary provider of inflation information to the respondents that participated in the survey, followed by televised news. Online sources of information (search engines, financial websites, online news, apps or social media) can vary significantly in terms of how information is presented. As a

result, it is difficult to attribute of any of the findings below directly to the online sources of information as the survey did not inquire further about the specifics of the online sources.

i. Discussing the results

a. Frame

The purpose of the research conducted in this paper was to understand the effect of the graphical and textual framing of inflation information on inflation estimations/predictions in surveys. There were two main components that were looked at: the effect of the frame on the accuracy as well as on the magnitude of predictions. This circles back to the research question:

“How does the framing effect of graphically or textually presented information influence the expectations of respondents in surveys regarding inflation?”

H1.1 and H1.2 were used to answer this question. H1.1 predicted that respondents using the graphical framing of information would produce more accurate results compared to respondents that used the textual frame. Due to the significant differences (the total absolute error of predictions from the graphical frame were 0.5 lower), H1.1 can be confirmed. On the other hand, H1.2 predicted that predictions from the textual frame would be overestimated to that of the graphical frame. There were no significant differences in the total answer of both groups.

To answer the research question: the framing effect of graphically or textually presented information influences the accuracy of expectations of respondents in surveys regarding inflation, but it does not influence the magnitude of expectations. As a result, the graphical framing of inflation information is superior to the textual framing of information when it comes to producing more accurate expectations.

H1.1 was formulated based on the previous studies of Franzblau and Chung (2012), Prasad and Ojha (2012) and Niu and Harvey (2021). By integrating their findings into the context of this research, the confirmation of H1.1 shows that graphs are better suited to assist individuals in visualizing and processing historical inflation data, which results in more accurate future inflation estimations.

b. Aligned Preferences

This research did not find any effects to support the notion that the aligning of information framing preferences can positively improve the quality and reliability of expectations. There is a lack of previous literature investigating the aligning of information framing preference. As a result, no conclusions can be

drawn about the effect of the aligning of information framing preferences on the expectations of respondents in surveys regarding inflation.

c. Informedness

There were no significant effects of the level of informedness of respondents on the magnitude nor accuracy of predictions in this research. H3 predicted that a higher level of informedness would be correlated with lower expectations (compared to the predictions of respondents with a lower level of informedness). In the graphical frame, the difference was minimal. However, in the textual frame, respondents with a lower level of informedness had a total answer that was 0.4 higher than that of respondents with a higher level of informedness. Although this difference wasn't significant, it supports the findings of Binder and Rodrigue (2018) and Rumler and Valderrama (2020) on which H3 was formulated.

It is possible that future research might find this difference to be statistically significant. Both of the aforementioned studies found a correlation between a higher level of informedness and lower expectations. Furthermore, Rumler and Valderrama (2020) also found that a higher (self-reported) level of informedness was correlated with a higher level of education and a higher inflation literacy. Keeping this in mind, the assumption can be made that the textual frame increases the gap between expectations of individuals with a higher and lower level of informedness. Specifically, presenting historical inflation data in a textual format might be harder for individuals with a lower level of informedness to process.

However, due to the lack of significant effects, this explanation remains hypothetical. It is possible that the overall level of informedness of respondents that participated in this survey was relatively similar. To better understand the level of informedness of respondents in future surveys, additional questions should be included that will allow for an assessment of the overall informedness level and inflation literacy of the individual respondents. Although Rumler and Valderrama (2020) found a correlation between a higher self-reported level of informedness with a higher inflation literacy, this does not necessarily hold true across other research. The self-reported level of informedness question can be prone to bias, different interpretations or even untruthfulness (Rosenman et al., 2011). Therefore, a more effective means of understanding the level of informedness of a respondent could be based on the specific questions that are asked to determine their actual inflation literacy and level of informedness on inflation. This information will allow future researchers to compare the self-reported level of

informedness to their own assessment of a respondent's level of informedness. Furthermore, by controlling for the newly assessed level of informedness, researchers will be able to better understand the effect of the level of informedness on inflation expectations. This can also be used in research similar to that of this paper which focuses on the effects of the different framing of information.

d. Gender

There were no significant effects of gender of respondents on the magnitude of predictions in this research. Based on previous literature (Bryan and Venkatu (2001), D'Acunto et al. (2021) and D'Acunto (2022), H5 was formulated to determine if women overestimate their predictions compared to their male counterparts in both frames. In the textual frame, the difference was minimal. However, in the graphical frame, the average female respondents had a total answer that was 0.3 higher than that of a male respondent. Although this difference was insignificant, it is in line with the findings of the previous literature. This brings to light some possible explanations: Are women more unfamiliar with graphs and interpreting them compared to men, since women are more likely to pursue a "care oriented" career (Karlsen, 2012)? Is the textual frame so inferior that both genders have difficulty in interpreting the information? To answer the first question, it would have been useful to inquire into the specific educational backgrounds and current occupational fields of the respondents, instead of only asking for their highest attained level of education. In the case of the second question, it is useful to look back at H1.2. This paper could not determine that the framing of information had any significant effects on the magnitude of predictions. Therefore, this question cannot be answered based on the research.

However, the lack of significant effects of the gender of respondents on the magnitude of predictions could be related to the study of D'Acunto et al. (2021). To summarize, D'Acunto et al. found that the "gender expectations gap" could explain the reason as to why women tend to overestimate their expectations; this was correlated with the extent to which different genders are exposed to volatile grocery prices (women are more likely to be responsible for grocery shopping in their household). Therefore, the lack of significant effects of gender in this paper could be explained by the fact that the male and female respondents that participated in the survey were potentially exposed to volatile grocery prices to a similar extent. As a result, the gender expectations gap would not have significantly influenced the magnitude of predictions in the survey. This could have been assessed by directly inquiring about the grocery shopping practices of a respondent relative to the rest of their household and the extent to which they are responsible for grocery shopping.

e. Age

There were no significant effects of the age of respondents on the magnitude of predictions in this research. Based on previous literature (Malmendier and Nagel (2016), Rumler and Valderrama (2020) and D'Acunto et al. (2022)), H6 was formulated to determine if older respondents overestimate their predictions compared to their younger counterparts in both frames. As mentioned in the methodology section, the survey used for this research used historical information from Sweden and the United Kingdom over the period of 2002 to 2018. However, the respondents were not made aware of the specific year nor country for which they were predicting the annual inflation rate at period 13. In the aforementioned literature, the studies made use of surveys commonly used by policy makers and the Federal Reserve. In these surveys, respondents make future inflation predictions based on current and recent economic conditions that they have been directly exposed to. These studies focus on more recent data from the surveys (1990s to 2021) and found that older respondents tend to overestimate their expectations. However, Malmendier and Nagel (2016) found that respondents predicate their inflation expectations based on the exposure to inflation throughout the entirety of their life-time. In the late 1970s and early 1980s (which saw unprecedented levels of inflation in the United States during that period), younger respondents overestimated their expectations as they based it on what they were witnessing at the time. Based on the work of Malmendier and Nagel (2016), a possible explanation for the lack of significant effects of the age of respondents on their predictions could be due to the fact that respondents were not made aware of the year nor country for which they were making their predictions.

f. Education

There were no significant effects on the level of education of respondents on the magnitude of predictions in either frame. H6 was formulated based on the findings of Burke and Manz (2014), Rumler and Valderrama (2020) and D'Acunto et al. (2022) which found a correlation between a higher level of education and lower expectations. Additionally, Burke and Manz (2014) found a correlation between a higher level of education and a higher level of economic literacy; Van der Cruysen et al. (2015) found a correlation with a better understanding of monetary policies; Rumler and Valderrama (2020) found a correlation with a higher level of inflation literacy. Similar to the question regarding level of informedness, this survey could have benefitted from additional questions that would have assessed the overall economic literacy and inflation literacy of the respondent. Having a low level of education does not imply economic illiteracy and vice-versa, having a high level of education does not cause economic

literacy. Therefore, the lack of significant effects with regards to H6 may be due to the fact that respondents have a similar level of economic literacy, although the level of education may differ. The additional questions that would be used to assess the actual level of informedness and inflation literacy of a respondent could be intertwined with questions that assess the overall economic literacy of a respondent.

With regards to the effect of the level of education of respondents on the accuracy of predictions, there was no difference in the total absolute error in the graphical frame. However, there was a significant difference of 0.4 in the textual frame. Respondents with a lower level of education had a total absolute error that was 0.4 higher than that of a respondent with a higher level of education. This shows that the level of education is correlated with the accuracy of the prediction of a respondent in the textual frame. The previous literature only looked at the magnitude of responses relative to that of different groups in order to see which groups tended to overestimate.

A possible explanation for this significant finding is that the effect of the level of education was minimal in the graphical frame was due to the relatively similar economic literacy of respondents. However, the extent to which a respondent can interpret and process the textual framing of historical inflation data may not have anything to do with economic literacy. Instead, this is where the level of education plays a role. For respondents that have obtained a degree from a university, regardless of the field, they are used to reading textbooks. University students need to be able to process significant amounts of text, compartmentalize the information and summarize the information in a way that will help them to pass examinations. This process will include filtering out information so that it is easier to remember and store the most important pieces of information relevant to a certain subject.

ii. Limitations of the research

There were several limitations encountered in this research. One of the major limitations was the lack of specific papers looking at the effect of graphical vs textual framing of information especially in the context of surveys. Similarly, it was difficult to find papers regarding the effect of the aligning of information framing preferences.

As mentioned in the methodology section, preventive measures should have been taken avoid bot/spam responses in the survey. This could have been prevented by incorporating a CAPTCHA test in the beginning of the survey. Another way to easily filter out bot responses would have been to incorporate “attention check questions” in the survey.

As mentioned through this section, the lack of significant effects of the level of informedness, gender and level of education of the respondents on the magnitude of predictions can be explained by the previous literature. With regards to gender, it is beneficial to ask questions that will assess whether the gender expectations gap exists (D'Acunto et al., 2021) by inquiring into the extent to which respondents are responsible for grocery shopping in their household. Similarly, it is important to ask questions that will assess the actual level of informedness of a respondent as well as their economic and inflation literacy. Other questions that could be included in future surveys similar to the survey conducted in this paper is to inquire about the specific educational background and current occupation of the respondents.

With regards to the primary source of inflation information for respondents, the survey would have benefited from differentiating between the different online sources instead of grouping them collectively under one group. As a result, it is not possible to make any specific conclusions about how the primary source of inflation information for the respondents impacted their predictions. The survey should have done a better job of informing the respondents that the scenarios were based on real historical data. For example, providing the year or the country for each scenario would have made this clearer to the respondent.

Conclusion

The confirmation of H1.1 shows that the framing of information has a significant effect on the accuracy of expectations. The graphical framing of historical inflation data improves the accuracy of future inflation predictions compared to the predictions made using the textual framing of information. Most surveys ask respondents about their expectations for inflation in the near future to understand consumer sentiment and their outlook on the economy. To improve the accuracy and reliability of these expectations, it is beneficial for these surveys to inquire about the specific sources from which respondents primarily obtain their inflation information from. It is important to differentiate between the sources as they utilize the graphical and textual framing to different extents. By controlling for this, future surveys can improve the overall accuracy of the expectations.

This finding also emphasizes the benefit of framing information related to data points (especially historical and temporal data) in a graph instead of in a textual format, as an individual will be able to better visualize and process the information more accurately.

As inflation surveys are utilized by policy makers and central banks in their constant battle to maintain price stability, it is essential to constantly strive to improve such surveys. The research in this paper is only a small contribution to an ever-growing list of studies conducted by dedicated academics with the primary goal of improving inflation surveys.

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Appendix

i. Primary source for inflation information amongst different demographics

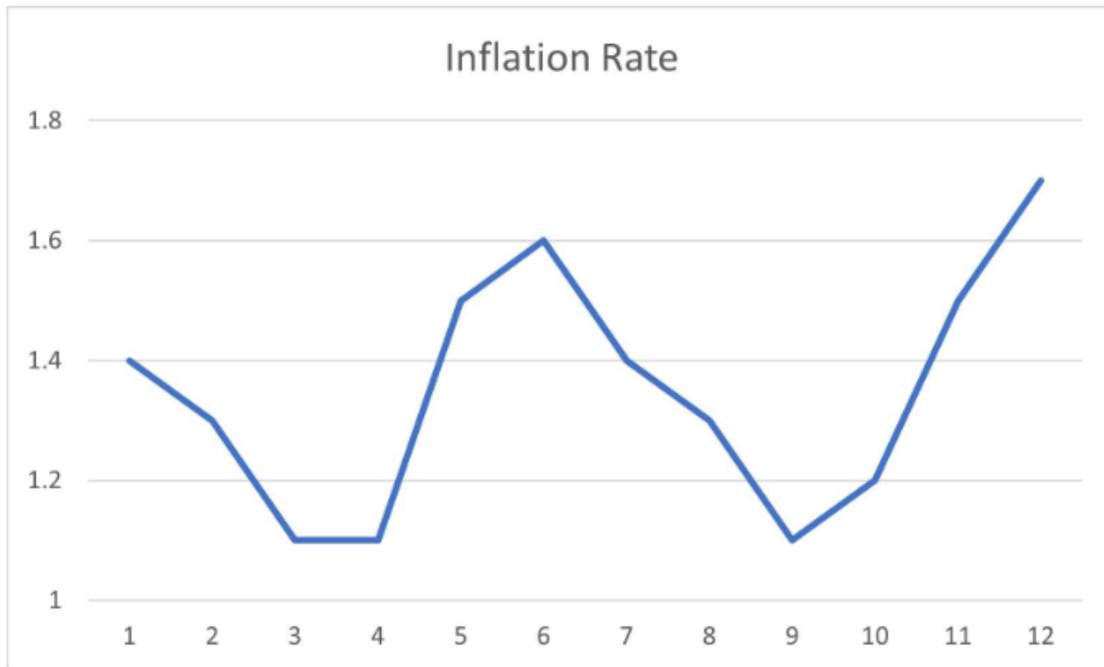
	SOURCE			
	Radio	Newspapers	Televised News	Online/Apps
Gender				
Female	1.79%	6.45%	12.19%	15.41%
Male	5.73%	7.53%	18.64%	32.26%
Age				
18-24	0.36%	1.79%	4.66%	10.75%
25-34	1.43%	3.94%	11.47%	20.79%
35-44	2.15%	4.66%	4.30%	7.89%
45-54	2.15%	0.72%	4.66%	4.30%
55-64	1.08%	2.51%	3.94%	2.51%
65-74	0.36%	0.36%	1.79%	1.43%
Education				
High-School Diploma	0.72%	1.08%	4.66%	9.68%
Associate Degree	1.08%	3.58%	8.24%	7.17%
Bachelor's Degree	4.30%	5.73%	11.11%	20.79%
Master's Degree	1.08%	3.23%	5.73%	8.60%
Doctoral Degree	0.36%	0.36%	1.08%	1.43%

Table 25: Primary source for inflation information amongst different demographics

ii. Scenarios used in the survey

Scenario 1 (Great Britain, 2004; Inflation rate at period 13 was 1.6%)

1. The following graph shows the annual inflation rate of country A over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

1. The following information describes the annual inflation rate of country A over 12 periods (January to December). Please use the information to answer the question below.

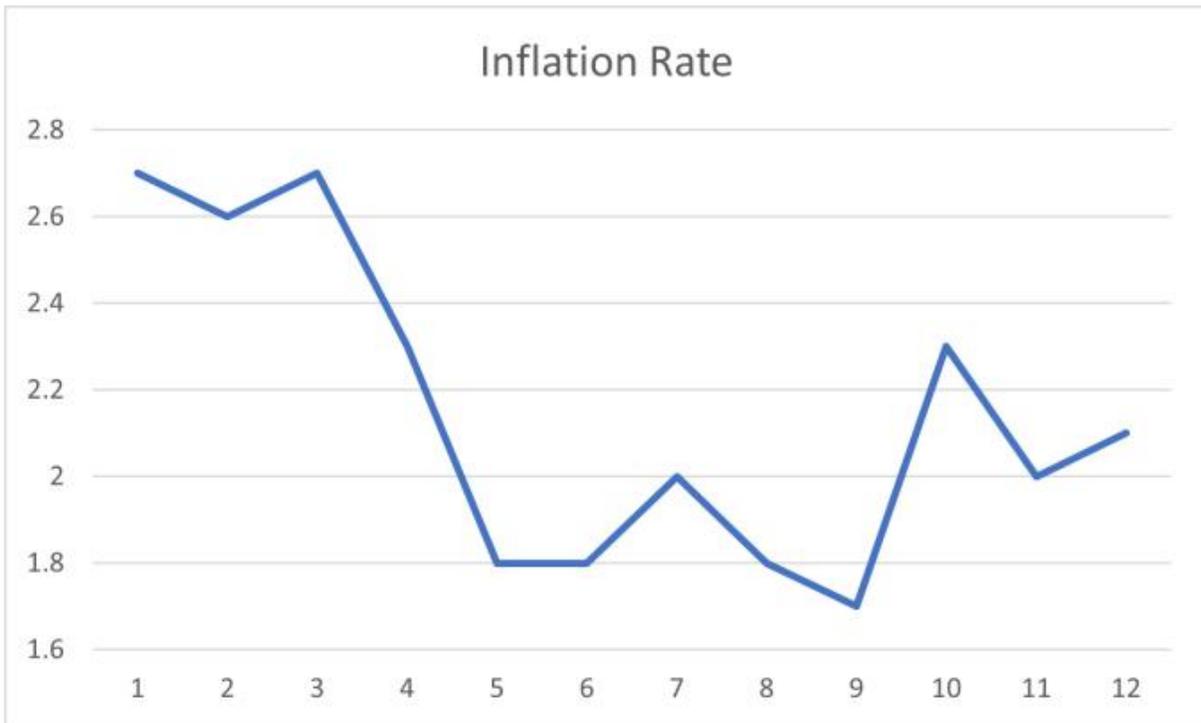
“The inflation rate of country A dropped from 1.4% in January to a low of 1.1% in March. By June, the inflation rate had increased to 1.6%, but fell back down to 1.1% in September. The remainder of the year saw a significant rise in the inflation rate, reaching a high of 1.7% in December.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

Scenario 2 (Sweden, 2002; Inflation rate at period 13 was 2.7%)

2. The following graph shows the annual inflation rate of country B over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

2. The following information describes the annual inflation rate of country B over 12 periods (January to December). Please use the information to answer the question below.

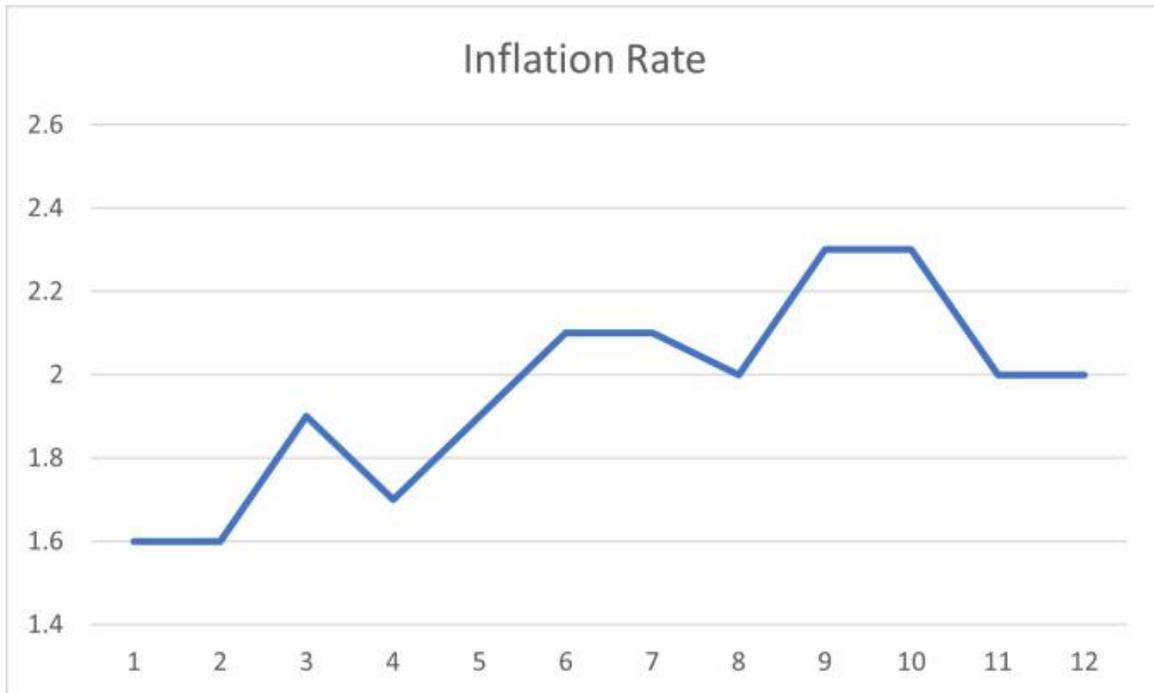
“The inflation rate of country B dropped from 2.7% in March to 1.8% in May. The inflation rate hovered around 1.8% for the next several months, reaching a low of 1.7% in September. The inflation rate climbed to 2.1% by the end of the year.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

Scenario 3 (Sweden, 2018; Inflation rate at period 13 was 1.9%)

3. The following graph shows the annual inflation rate of country C over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

3. The following information describes the annual inflation rate of country C over 12 periods (January to December). Please use the information to answer the question below.

“The inflation rate of country C increased from a low of 1.6% in February to a high of 2.3% in September and October. The inflation rate dropped to 2% for the remainder of the year.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

Scenario 4 (Great Britain, 2012; Inflation rate at period 13 was 2.7%)

4. The following graph shows the annual inflation rate of country D over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

4. The following information describes the annual inflation rate of country D over 12 periods (January to December). Please use the information to answer the question below.

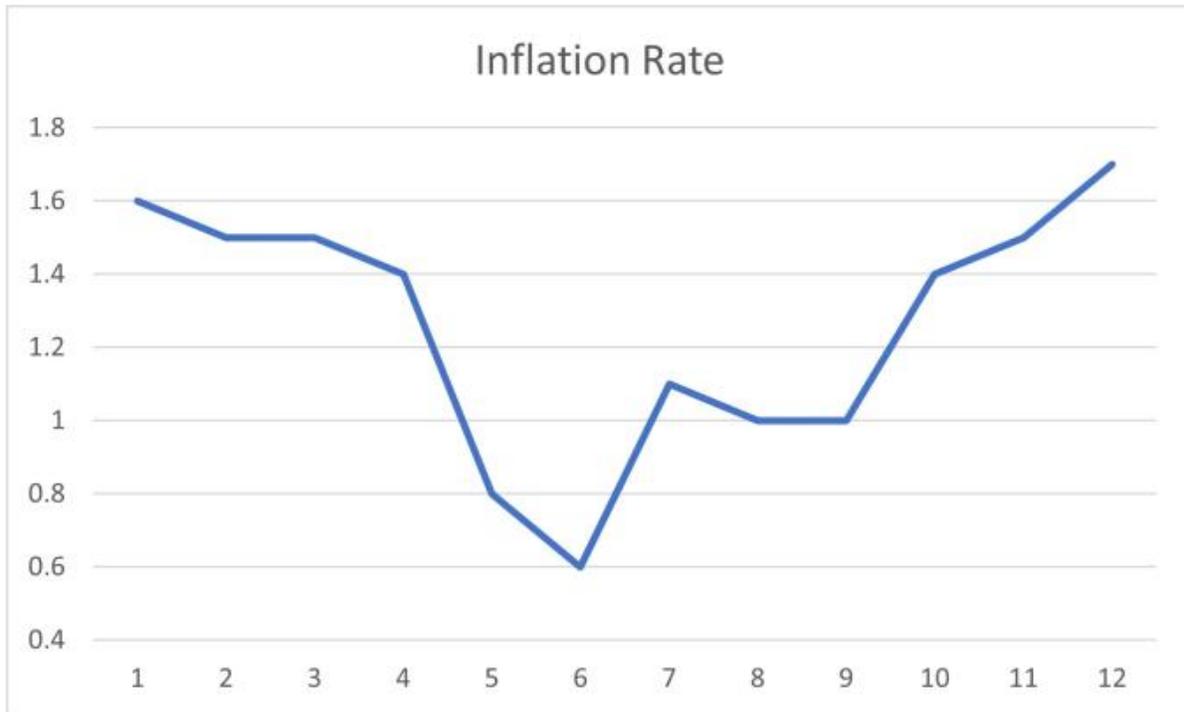
“The inflation rate of country D decreased from a high of 3.6% in January to a low of 2.2% in September. The inflation rate climbed to 2.7% for the remainder of the year.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

Scenario 5 (Great Britain, 2002; Inflation rate at period 13 was 1.3%)

5. The following graph shows the annual inflation rate of country E over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

5. The following information describes the annual inflation rate of country E over 12 periods (January to December). Please use the information to answer the question below.

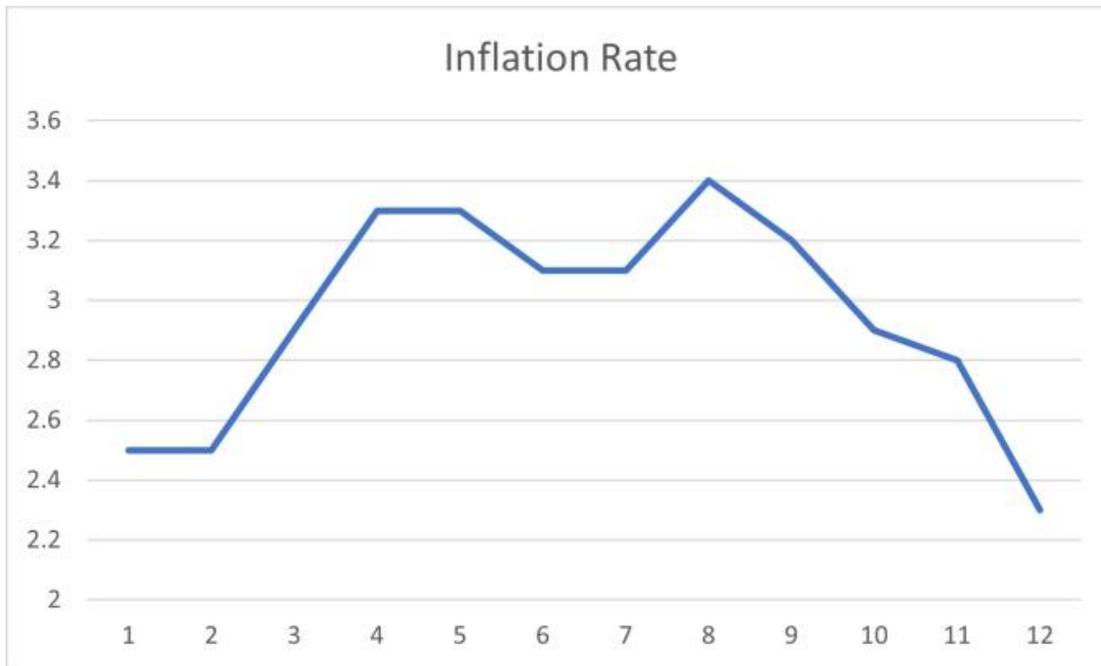
“From January to June, the inflation rate of country E decreased from 1.6% to 0.6%, with the largest drop seen in the month of May. For the remainder of the year, the inflation rate gradually increased, reaching a high of 1.7% in December.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

Scenario 6 (Sweden, 2011; Inflation rate at period 13 was 1.9%)

6. The following graph shows the annual inflation rate of country F over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

6. The following information describes the annual inflation rate of country F over 12 periods (January to December). Please use the information to answer the question below.

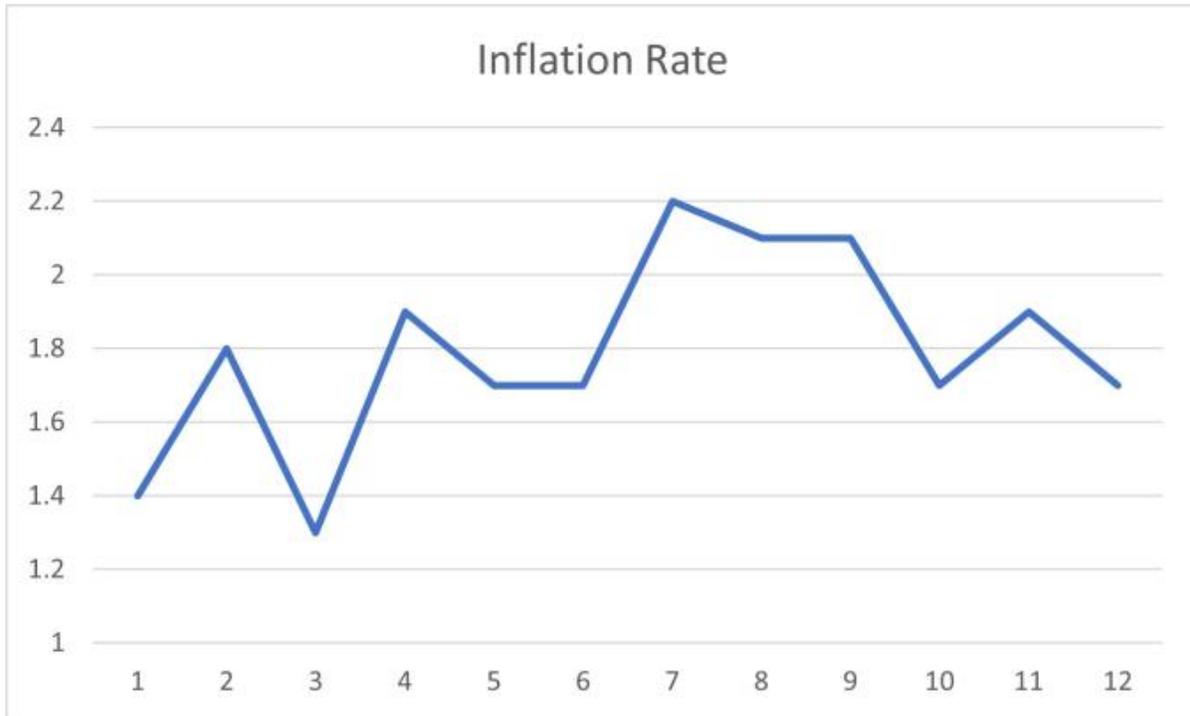
“The inflation rate of country F increased from 2.5% in February to 3.3% in April. The inflation rate hovered around 3.2% for the next several months, reaching a high of 3.4% in August. The remainder of the year saw a steady decline in the inflation rate, reaching a low of 2.3% in December.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

Scenario 7 (Sweden, 2017; Inflation rate at period 13 was 1.6%)

7. The following graph shows the annual inflation rate of country G over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

7. The following information describes the annual inflation rate of country G over 12 periods (January to December). Please use the information to answer the question below.

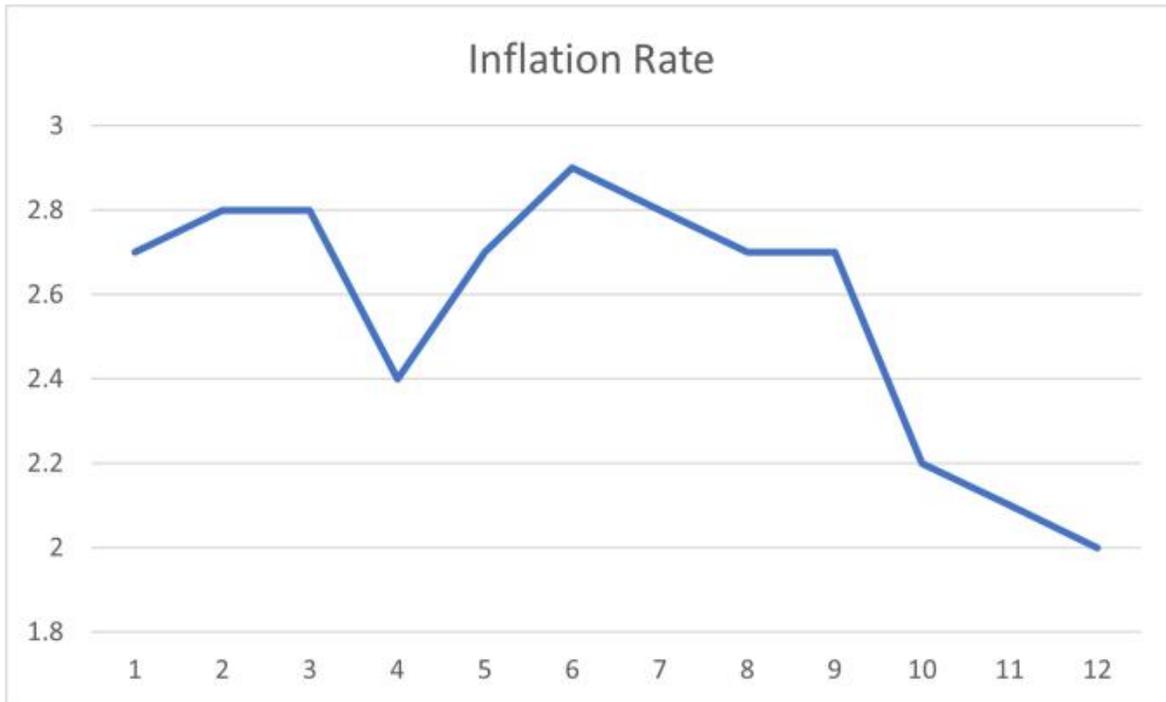
“The inflation rate of country G dropped from 1.8% in February to a low of 1.3% in March. The inflation rate gradually increased over the next several months, reaching a high of 2.2% in July. The remainder of the year saw steady decline in the inflation rate, falling to 1.7% in December.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

Scenario 8 (Great Britain, 2013; Inflation rate at period 13 was 1.9%)

8. The following graph shows the annual inflation rate of country H over 12 periods (January to December). Please use the graph to answer the question below.



What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

8. The following information describes the annual inflation rate of country H over 12 periods (January to December). Please use the information to answer the question below.

“The inflation rate of country H dropped from 2.8% in March to 2.4% in April. By June, the inflation rate reached a high of 2.9%. The remainder of the year saw the inflation rate gradually decrease to a low of 2% in December, with the largest drop seen in the month of October.”

What will be the inflation rate at period 13 (the next month)?

You can use up to 1 decimal point.

iii. Testing for the assumption of linearity

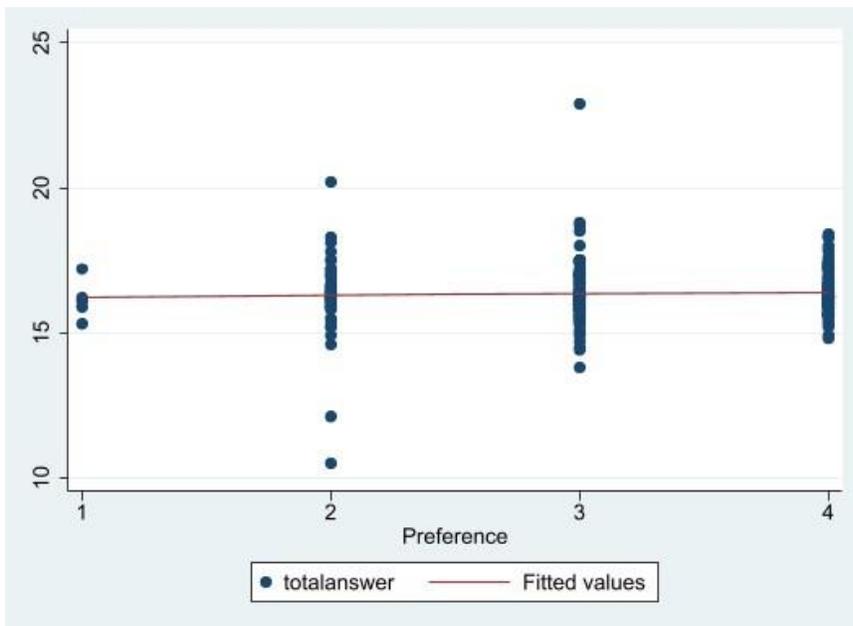


Figure 5. Total answer vs Preference

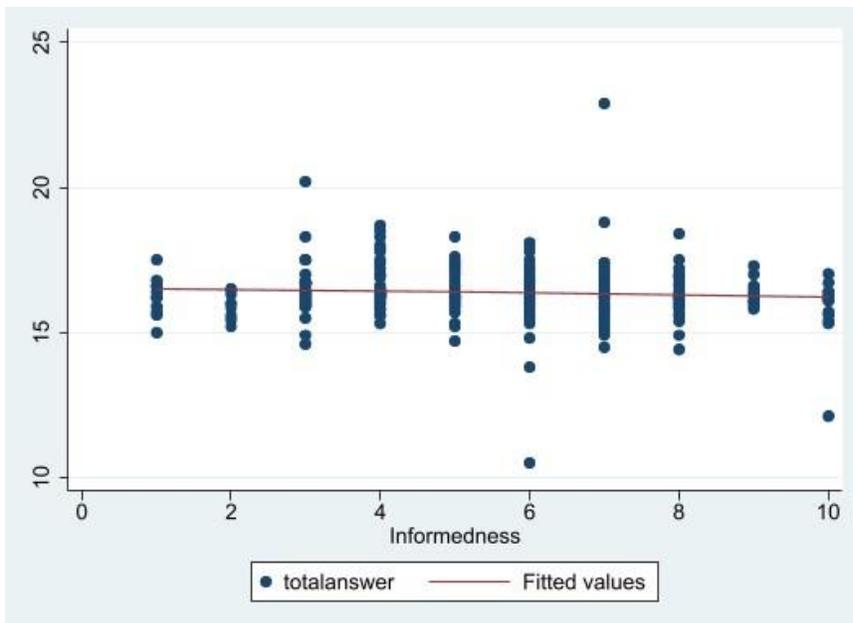


Figure 6. Total answer vs Informedness

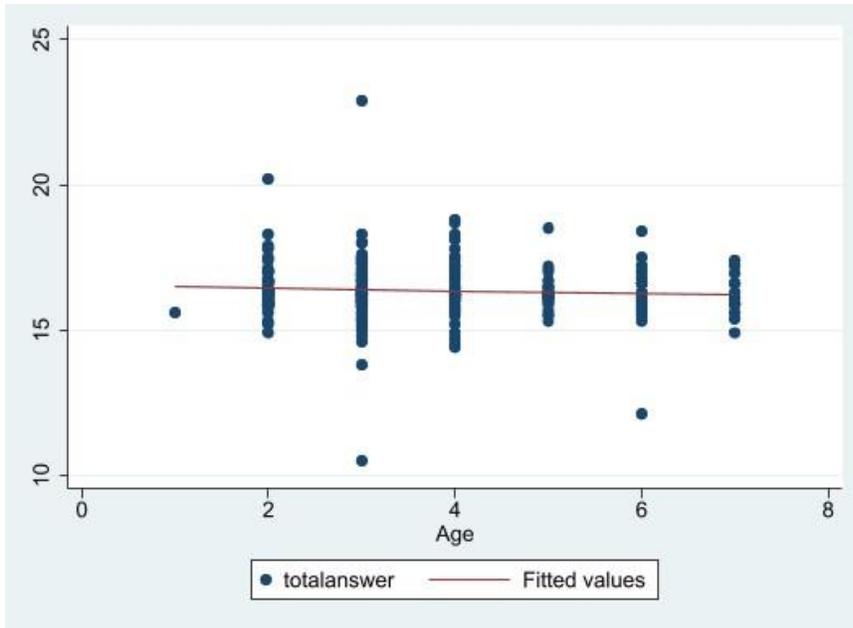


Figure 7. Total answer vs Age

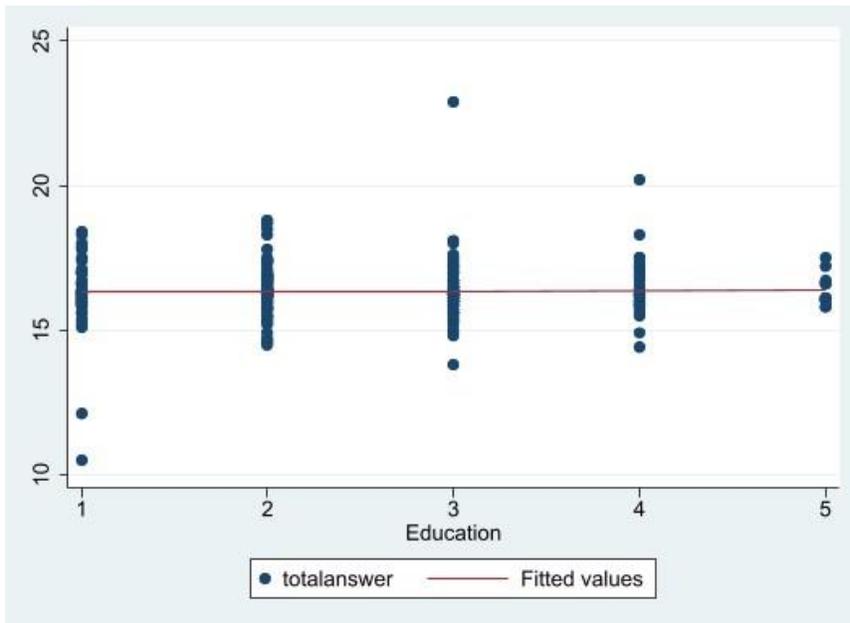


Figure 8. Total answer vs Education

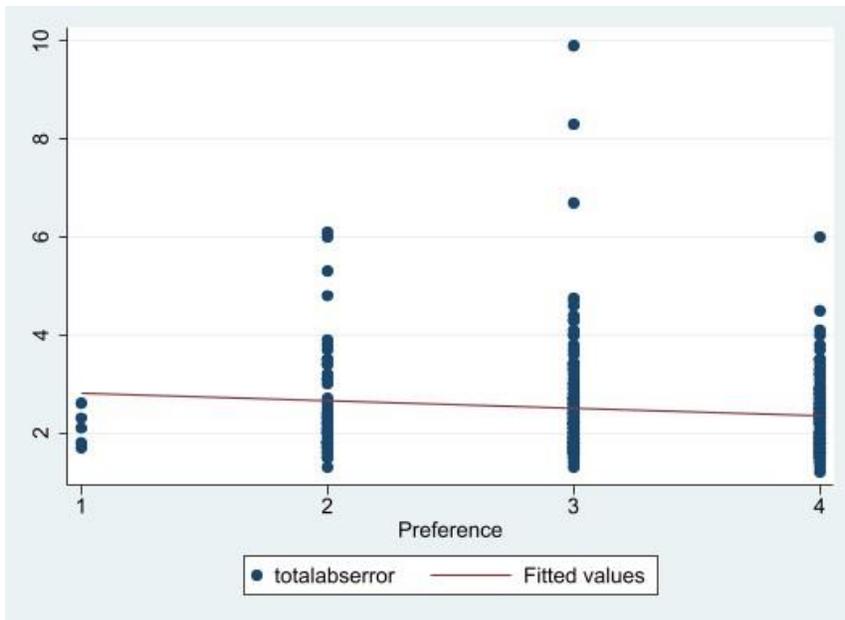


Figure 9. Total absolute error vs Preference

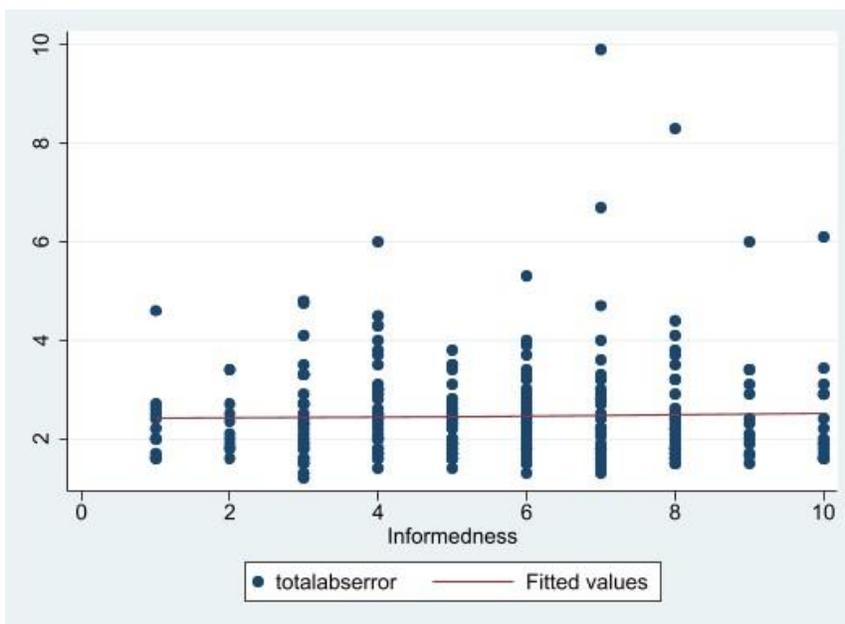


Figure 10. Total absolute error vs Informedness

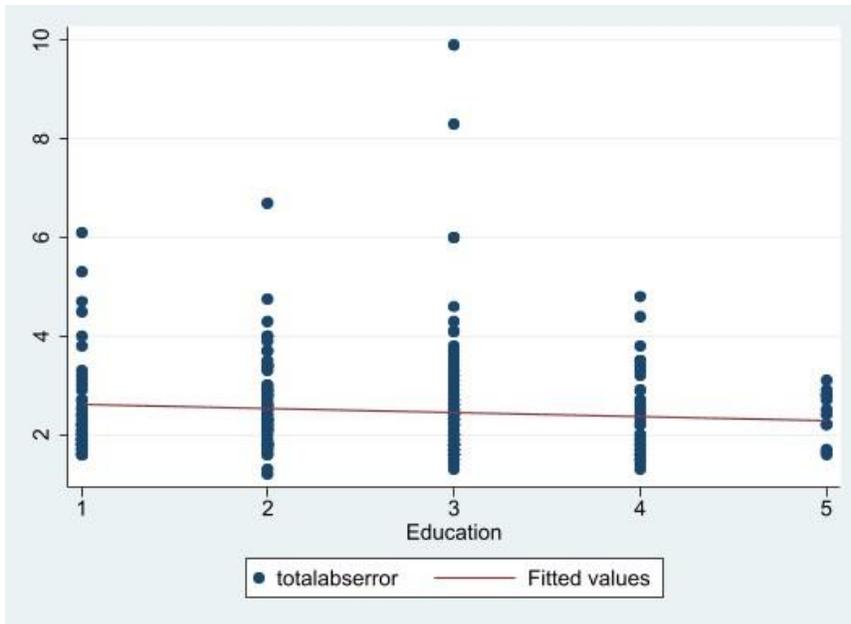


Figure 11. Total absolute error vs Education

iv. Testing for the assumption of multicollinearity

CORRELATION MATRIX						
	Frame	Preference	Informedness	Gender	Age	Education
Frame	1.0000					
Preference	0.0907	1.0000				
Informedness	0.1112	0.1502	1.0000			
Gender	-0.0307	0.0090	0.1604	1.0000		
Age	0.1206	0.0958	0.2935	0.1628	1.0000	
Education	0.0049	0.0853	0.2132	0.1127	0.1929	1.0000

Table 26. Correlation matrix of independent variables